(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 624 039 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **94302776.3**

(51) Int. Cl.[5] : **H04N 7/173**

(22) Date of filing : **20.04.94**

(30) Priority : **03.05.93 US 56973**

(43) Date of publication of application :
09.11.94 Bulletin 94/45

(84) Designated Contracting States :
DE ES FR GB IT

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(54) Integrated television services system.

(57) A system is disclosed for delivering audio and/or video signals to users in connection with the provision of interactive television services. Various sources of such signals are connected to a digital network (10), such as a packet network. Also connected to such network are control (100) and application (102) processors and interfaces (112,114) to distribution arrangements such as cable television systems (116) and telephone subscriber loops (118). Each user has a signal converter (130,150) for receiving a digital signal from the distribution arrangement, converting such signal for viewing on a conventional television receiver (134) and transmitting control packets to other elements of the system. The signal sources can include a data cache (104) for storing recorded video and audio materials, a broadcast source (108) for receiving broadcast signals, apparatus (106) for composing multimedia signals from multiple sources, and apparatus (110) for running games. The various elements of the system can be situated at different geographical locations and operated by the control and/or application processors (100,102) under software control to provide a variety of interactive television services.

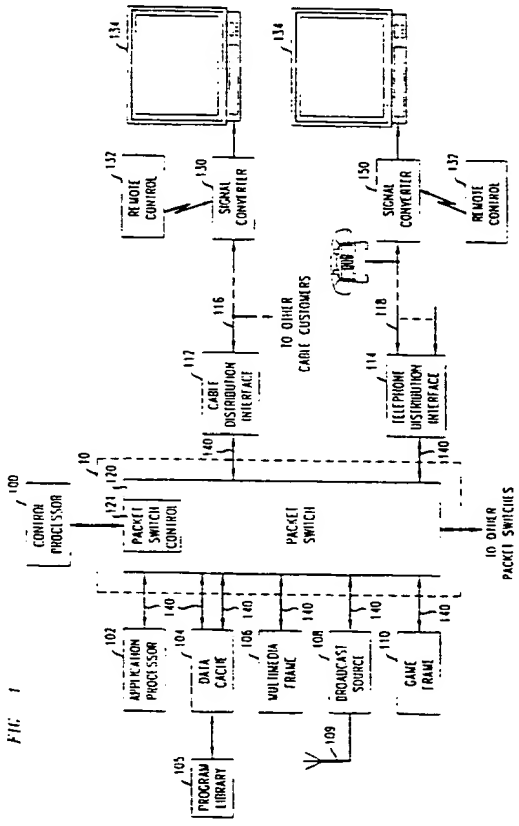

FIG. 1

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of control and data packets in a system configured in accordance with the invention.

FIG. 3 is a block diagram of an interface for distributing integrated television services over a cable television system.

FIG. 4 is a block diagram of a signal converter for use by a cable television system customer.

FIG. 5 is a block diagram of an interface for distributing integrated television services over telephone subscriber loops.

FIG. 6 is a block diagram of a signal converter for use by a telephone subscriber.

FIG. 7 is a diagram of a menu screens used that can be displayed by the system of the invention.

FIG. 8 is a flow chart showing the operation of the invention in selecting and showing a movie.

Detailed Description

FIG. 1 is an overall block diagram of a basic integrated television services system configured in accordance with the invention. The elements of the system communicate through packet network 10, which includes one or more packet switches 120. Such elements include control processor 100, application processor 102, application resources such as data cache 104, multimedia frame 106, broadcast source 108 and game frame 110 and one or more distribution interfaces 112 and 114, all of which are connected by links 140 to packet switch 120. Program library 105 is a high-capacity, long-term source of stored program material for data cache 104. Broadcast source 108 furnishes digitized and compressed program material from television broadcasts, cable systems, satellites or other means. In an exemplary embodiment, packet network 10 is an asynchronous transfer mode (ATM) network, links 140 are SONET OC-3 links, and packet switch 120 is an ATM switch such as the AT&T GCNS-2000 ATM switch.

In general, control processor 101 serves to interact with users selecting any of the various interactive services that may be provided by the system of the invention, and application processor 102 controls the services themselves. Control processor 101 also assigns the resources necessary to provide a service to a user. Application processor 102 and application resources such as data cache 104, multimedia frame 106, broadcast source 108 and game frame 110 can be duplicated as necessary to meet the capacity requirements of the system, but control processor 101 is preferably not duplicated because such processor maintains assignment records for the various resources in the system and making such records available to more than one processor, while achievable, is cumbersome. However, these task assignments to control processor 101 and application processor 102 are not inviolate, for example, in some applications it may be desirable to combine the functions of both processors in a single processor, or to use control processor 101 for certain applications.

Data cache 104 is a large random access memory for storing audio and video material in compressed and packetized form, such as the program server described in our copending patent application Serial No. 07/997,985 filed December 29, 1992. Data cache 104 can have one or more links 140 into packet network 10 depending on capacity requirements. Program library 105 can be a large-capacity system of any convenient type for storing program material, such as movies, musical selections, video clips, still frames and audio clips, in digitized and compressed form on devices such as magnetic tapes or optical discs and the like. Link 142 between program library 105 and data cache 104 can also be made via a separate ATM packet network, such as a SONET OC-3 network, or via packet network 10, depending on capacity and geographic limitations. Program library 105 is typically equipped to transmit a large quantity of data, such as digitized and compressed video and audio signals for complete movies, to data cache 104 in a relatively short time, as described in more detail in our above mentioned application.

It is contemplated that the various elements shown in FIG. 1 can be situated at different geographic locations. For example, packet switch 120, control processor 100, application processor 102, multimedia frame 106, broadcast source 108 and game frame 110 can be at a first location, data cache 104 can be at a second location and program library 105 can be at a third location. Other packet switches 120 and distribution interfaces such as 112 and 114 can be at still other locations. Connections between locations are SONET OC-3 links. It will be clear to those skilled in the art that numerous possible combinations of and locations for such elements are possible without departing from the spirit and scope of the invention.

Many interactive television services may be offered that incorporate broadcast television programs. Therefore, one of the application resources provided in the system of the invention can be a source of such programs, such as broadcast source 108, which receives one or more broadcast television signals from regular broadcasts, from satellite transmissions, from cable television systems or from any other appropriate means, all symbolized by antenna 109. Broadcast TV source 108 includes facilities for digitizing and compressing each received television signal and transmitting such signals in packetized form via packet network 10.

Multimedia frame 106 contains a number of units for composing compressed and packetized multimedia signals from a number of different sources, such as data cache 104, broadcast source 108 and internal text generators. Each such source typically provides a signal in digitized and compressed form. When a multimedia signal composed from multiple video

sources 104, 105, 106, 108 and 110 by means of control packets. Data packets from program library 105 to data cache 104 can be sent via a direct link or via a packet network; even via packet network 10, if convenient. The link between application processor 102 and program library 105 carries only control packets and can be of lower capacity than links 140, for example, such link can be part of an Ethernet (tm) network. However, such link can also be a low-bandwidth virtual channel in packet network 10, if desired.

The flexibility of packet network 10 makes possible flows of data and control packets between any pair of terminals and from one terminal to groups of terminals. Possibly useful paths for control packets that are not shown are between signal converters 130 and 150 on the one hand to multimedia frame 106 and game frame 110 on the other. These paths may be desirable for use in time-dependent interactive applications using multimedia frame 106 and game frame 110 in which an extremely fast response to an action by a user is desired. Multimedia frame 106 and game frame 110 will typically include processors that can generate and respond to such control packets. Similarly, if control processor 100 also performs the functions of application processor 102, paths for control packets will be needed from control processor 100 to the various resources 102, 104, 105, 106, 108 and 110.

In general, control processor 100 interacts with users to control requested services and to assign the various resources needed to furnish the services, including the necessary virtual channels in packet network 10 and the various other links in the system. During the delivery of a service by application resources 104, 106 and 110, under control of application processor 102, control processor 100 maintains supervision by responding to certain control packets from signal converters 130 and 150; application processor 102 responds to control packets from signal converters 130 and 150 specifically relating to an ITV service being delivered. However, as described above, application resources may be equipped to respond directly to control packets from signal converters 130 and 150.

FIG. 3 is a block diagram of interface 112 for use at a cable television system headend for distributing integrated television services over a cable system in accordance with the invention. ATM interface 310 receives packets from packet network 10 over link 140, forwards data packets to downstream demultiplexer (DEMUX) 312 and forwards control packets addressed (in the body) to control 314. Certain types of control packets set up interface 310 to transmit packets over the various cable feeders originating at the headend, for example, feeders 350 and 352, based on the header contents of the packets. Thus, interface 112 also acts as a packet router or switch. Demultiplexer 312 routes all the data and control packets for a particular cable feeder to a downstream RF modulator, such as modulator 316 for feeder 350 and modulator 318 for feeder 352. Such control packets can, for example, include a converter address and information on virtual channels from which such converter is to receive packets containing audio and video data. These RF modulators convert the digital bit streams from demultiplexer 312 to modulated signals for transmission over one or more of the standard distribution channels (typically 6 mHz wide) in the cable system. Such modulation can be, for example, quadrature amplitude modulation such as 64 QAM. Other programs from standard cable program sources are modulated onto other channels and sent over other distribution channels in the cable system by amplifiers 330, as is well known in the art.

Control packets from signal converters 130 situated at cable customer locations are received by upstream RF demodulators such as demodulators 320 and 322. Such signals are typically sent in the 5-30 MHz band. Upstream multiplexer (MUX) 324 converts the bit streams from the various demodulators into appropriate virtual channels for transmission over packet network 10 via ATM interface 310. For example, control packets relating to particular ITV services can be assigned to a particular virtual channel assigned to such service and routed to the appropriate destination for such service.

FIG. 4 is a block diagram of a signal converter 130 for use at the premises of a cable customer receiving ITV services. A similar converter having additional features is described in copending application Serial No. 07/965,492, filed October 23, 1992. Input cable 402 is typically a coaxial cable or an optical fiber cable connected to the cable distribution system. Cable 402 is connected to inputs of band-stop filter 404 and ITV channel receiver 408 and to the output of uplink modulator 410. Cable 402 is part of an input circuit (not shown), that also contains any interface apparatus, such as optical/electrical transducers and amplification and buffering circuits needed to connect the cable system to filter 404, receiver 408 and modulator 410. Such interface apparatus and amplification and buffering circuits are well known to those skilled in the art.

ITV channel receiver 408 is tuned to receive the cable channel over which the packetized digital information for the interactive television features is being transmitted. The actual cable channel or channels used for such purpose are assigned by the administrators of the cable system. If more than one such ITV channel is provided, one of the channels is usually considered the "default" channel, which is the channel used to initialize converters such as converter 130. Upon initialization, a converter can be transferred to a different ITV channel by means of a control message. The output of tuner 408 is a digital bit stream comprising the packetized digital information.

routes video data packets to digital decoder 658 and audio data packets to audio decoder 660. Channel modulator 662 generates a conventional television signal from the outputs of decoders 658 and 660 and sends such television signal to the user's television receiver via lead 664. The subscriber's telephone 654 is also connected to interface 652.

Manual input devices 670 and output devices 672 are also connected to controller 656 as described for corresponding elements 418 and 420 in FIG. 4. On receipt of inputs from input devices 670, controller 656 generates appropriate control packets for transmission over subscriber loop 518 via subscriber loop interface 652.

FIG. 7 is a diagram of an example of a menu screen 700 for use in interactions with users of the system of the invention. Such a menu screen can be displayed to a user first gaining access to the system on the user's television set, and is an example of a multimedia program composed in multimedia frame 106 (FIG. 1). Menu screen 700 consists of three scaled-down full-motion video images 720, 730 and 740 displayed in window overlays on a still-frame background 710 and with superimposed text 750. Display of such a screen is typically accompanied by appropriate background audio, such as a stereophonic musical selection.

Control processor 100 typically controls transmission of a menu screen, such as menu screen 700, to signal converters 130 and 150 for users not currently using ITV services (inactive users) and monitors uplink messages from such signal converters. The menu screen is somewhat analogous to dial tone in a telephone system, and can be "broadcast" to multiple users by transmitting the audio and video portions of the screen over dedicated virtual channels in packet network 10 and enabling signal converters 130 for idle cable-customer users (and concentrator 512 for idle telephone-subscriber users) to receive such dedicated virtual channels. However, there can be multiple menu screens for different groups of users who, for example, subscribe to different packages of interactive television services.

To generate menu screen 700, application processor 102 assigns a composing unit in multimedia frame 106 and control processor 100 assigns virtual channels in packet network 10 for routing the appropriate audio and video signals for the elements in the menu screen, in digitized and compressed form, to multimedia frame 106 and such composing unit. The full-motion video packets for the movie excerpt to be shown in window 720 and the game teaser to be shown in window 740 and audio packets for the background audio are stored in data cache 104. The video signal for the shopping channel to be shown in window 730 is supplied by broadcast source 108. The still-frame background is stored and the text is generated in the composing unit. Thus, four virtual channels through packet switch 10 from data cache 104 to multimedia frame 106 are needed for the current-movie video, the game-teaser video and the stereophonic background audio; one virtual channel from broadcast source 108 to multimedia frame 106 is needed for the shopping channel video and three virtual channels are needed from multimedia frame 106 to distribution interfaces 112 and/or 114 are needed for the multimedia signal (one video, two audio) for the menu screen itself.

In order to more fully explain the operation of the system of the invention, reference will be made to the flow chart of FIG. 8, which represent an interaction in which a cable-customer user requests a movie from a video-on-demand service and the movie is presented using apparatus as shown in FIG. 1. In the numbered steps shown in FIG. 8, a "C" indicates that control processor 100 controls the step and an "A" indicates that application processor 102 controls the step.

Referring now to FIG. 8, control processor 100 causes a menu, such as menu screen 700, to be received by signal converters 130 and 150 of all inactive users (step 800). A user requests a particular ITV function by first selecting the channel on which the ITV service is furnished, which causes the main menu to appear on the user's television set (step 802). Then, using an input device such as remote control 132, the user selects the "Movie" category (step 804). This causes signal converter 130 to transmit a control packet addressed to control processor 100 indicating the type of ITV service requested. Control processor 100 then assigns virtual channels for transmission of the movie to the requesting user and initiates a movie selection process in application processor 102 for the user. The movie selection process causes one or more menu screens for movie selection (which can be created in multimedia frame 106) to be transmitted to the requesting user (step 806). Control packets from the user are directed to application processor 102 during the selection process. When the user selects a movie (step 808), application processor 102 determines whether the movie is stored in data cache 104 (step 810). If not, then application processor 102 causes program library 105 to download the movie (at high speed) to data cache 104 (step 812).

As described in our above mentioned application, various audio/video materials are stored in a large random-access memory, such as data cache 104, in compressed and packetized form and retrieved for a given user by referring to a pointer or pointers associated with that user. Commands from the user can modify the pointers; thus, the user can request actions such as pause, rewind, fast forward and the like. Such commands entered by the viewer on an input device such as remote control 132 are sent by signal converter 130 or 150 to application processor 102 in

one or more control signals to said at least one source in accordance with said received commands;

at said source, transmitting said digital signals to said user in response to said control signals.

14. The method of claim 13 which further comprises:

transmitting said commands, said control signals and said digital signals in the form of digital packets.

15. The method of claim 13 wherein said digital signals represent audio and/or video signals, which further comprises:

for each user, converting said digital signals received from said source to audio and/or video signals.

16. The method of claim 13 wherein at least one of said digital signals delivered to a user is a combined digital signal made up of multiple component digital signals, which further comprises:

transmitting said component digital signals from multiple ones of said sources to combining means;

at said combining means, combining said component digital signals to form said combined digital signal and transmitting said combined digital signal to said user.

17. The method of claim 16 wherein said combined signal is a multimedia signal and said component signals are video and/or audio signals in digital form.

18. The method of claim 13 wherein a digital signal from one of said sources is transmitted to multiple users, which further comprises:

storing said given digital signal in said source and

retrieving said stored digital signal and transmitting said stored digital signal separately for each one of said multiple users.

19. Apparatus for delivering digital signals from at least one source to at least one user in response to commands from said user, which comprises:

means for transmitting said commands to processing means;

at said processing means, means for transmitting one or more control signals to said at least one source in accordance with said received commands;

at said source, means for transmitting said digital signals to said user in response to said control signals.

20. The apparatus of claim 19 which further comprises:

means for transmitting said commands, said control signals and said digital signals in the form of digital packets.

21. The apparatus of claim 19 wherein said digital signals represent audio and/or video signals, which further comprises:

for each user, means for converting said digital signals received from said source to audio and/or video signals.

22. The apparatus of claim 19 wherein at least one of said digital signals delivered to a user is a combined digital signal made up of multiple component digital signals, which further comprises:

means for combining said component digital signals to form said combined digital signal and transmitting said combined digital signal to said user.

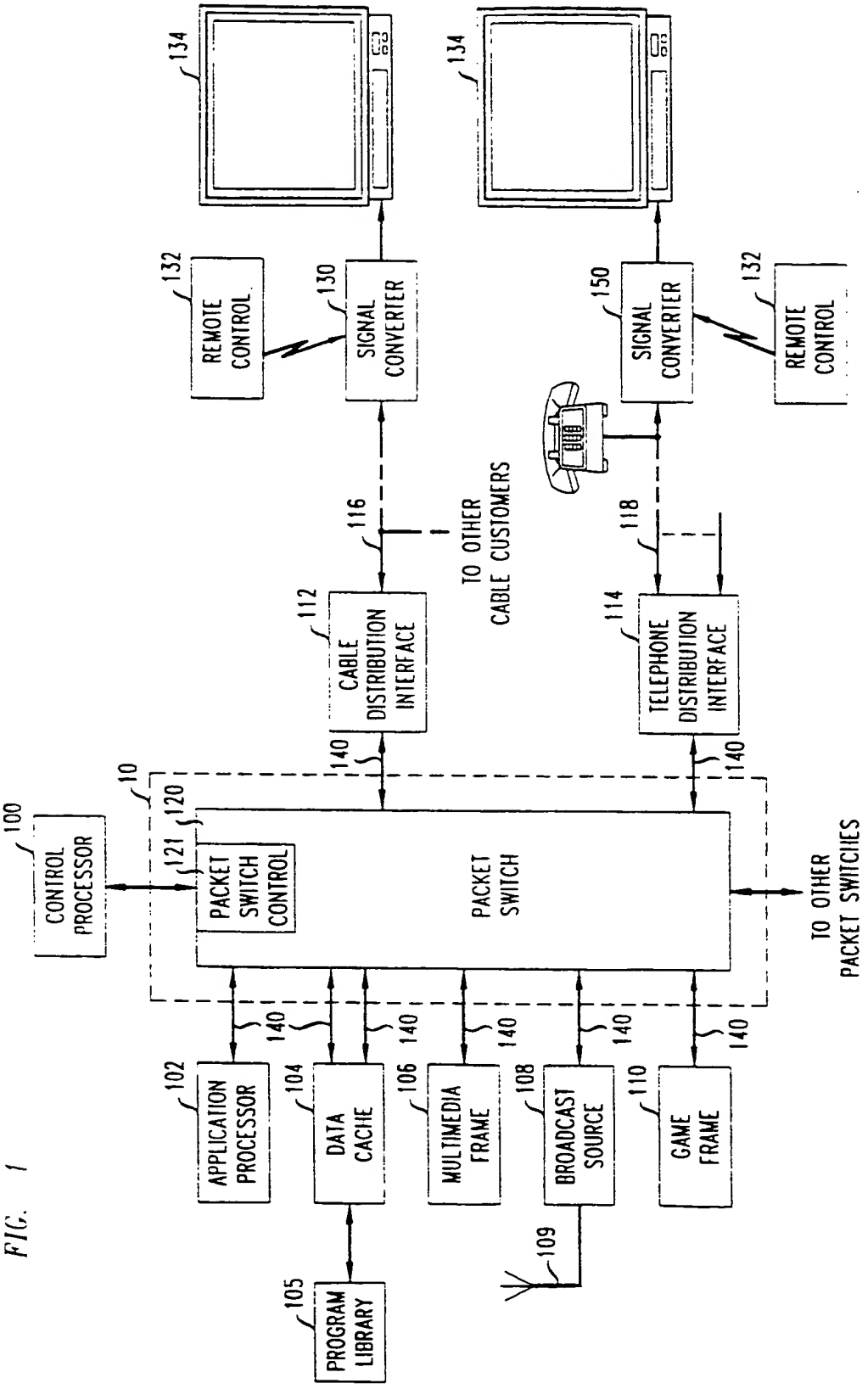

134
134
REMOTE CONTROL
132
SIGNAL CONVERTER
130
SIGNAL CONVERTER
150
REMOTE CONTROL
132
116
118
TO OTHER CABLE CUSTOMERS
CABLE DISTRIBUTION INTERFACE
112
TELEPHONE DISTRIBUTION INTERFACE
114
140
140
10
120
100
CONTROL PROCESSOR
121
PACKET SWITCH CONTROL
PACKET SWITCH
TO OTHER PACKET SWITCHES
140
140
140
140
140
102
APPLICATION PROCESSOR
104
DATA CACHE
106
MULTIMEDIA FRAME
108
BROADCAST SOURCE
110
GAME FRAME
109
105
PROGRAM LIBRARY

FIG. 1

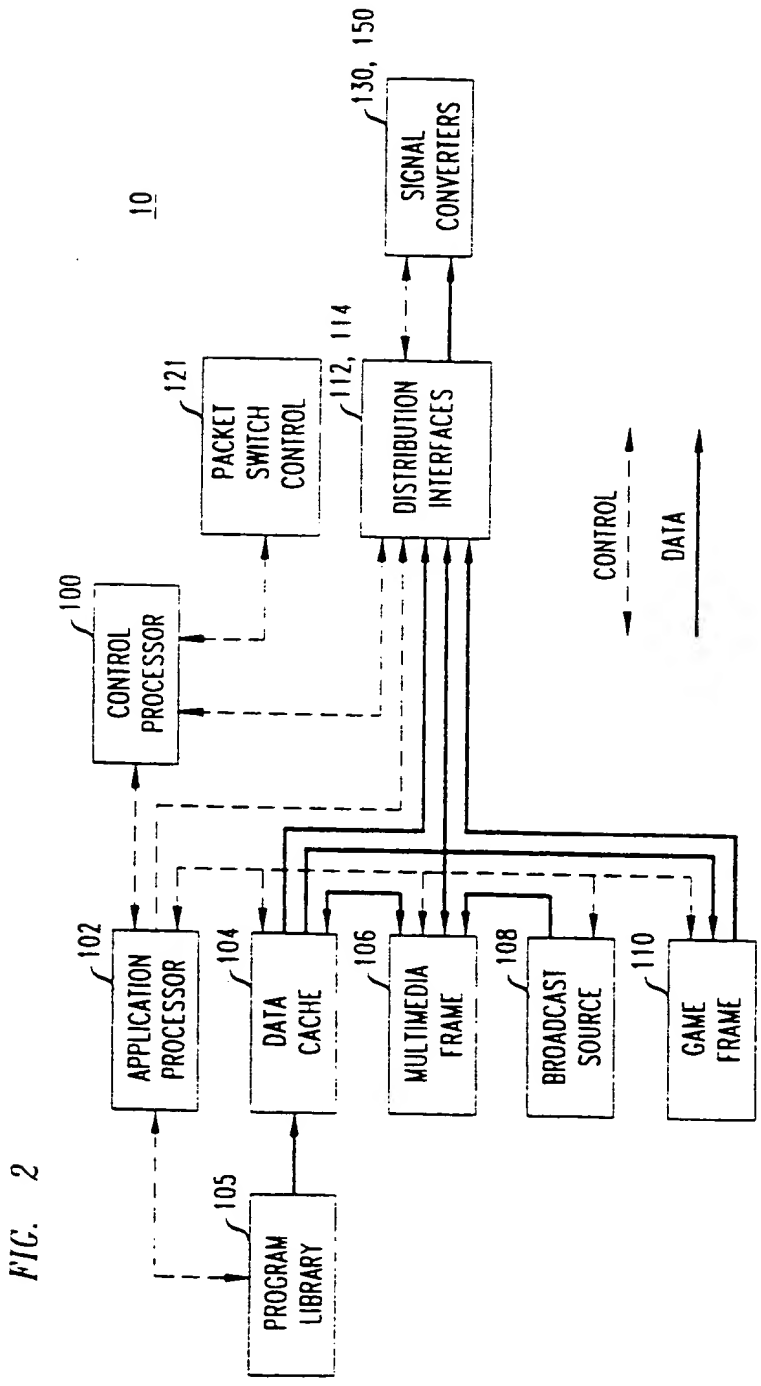

10
130, 150
SIGNAL CONVERTERS
121
PACKET SWITCH CONTROL
112, 114
DISTRIBUTION INTERFACES
CONTROL
DATA
100
CONTROL PROCESSOR
102
APPLICATION PROCESSOR
104
DATA CACHE
106
MULTIMEDIA FRAME
108
BROADCAST SOURCE
110
GAME FRAME
105
PROGRAM LIBRARY

FIG. 2

FIG. 3

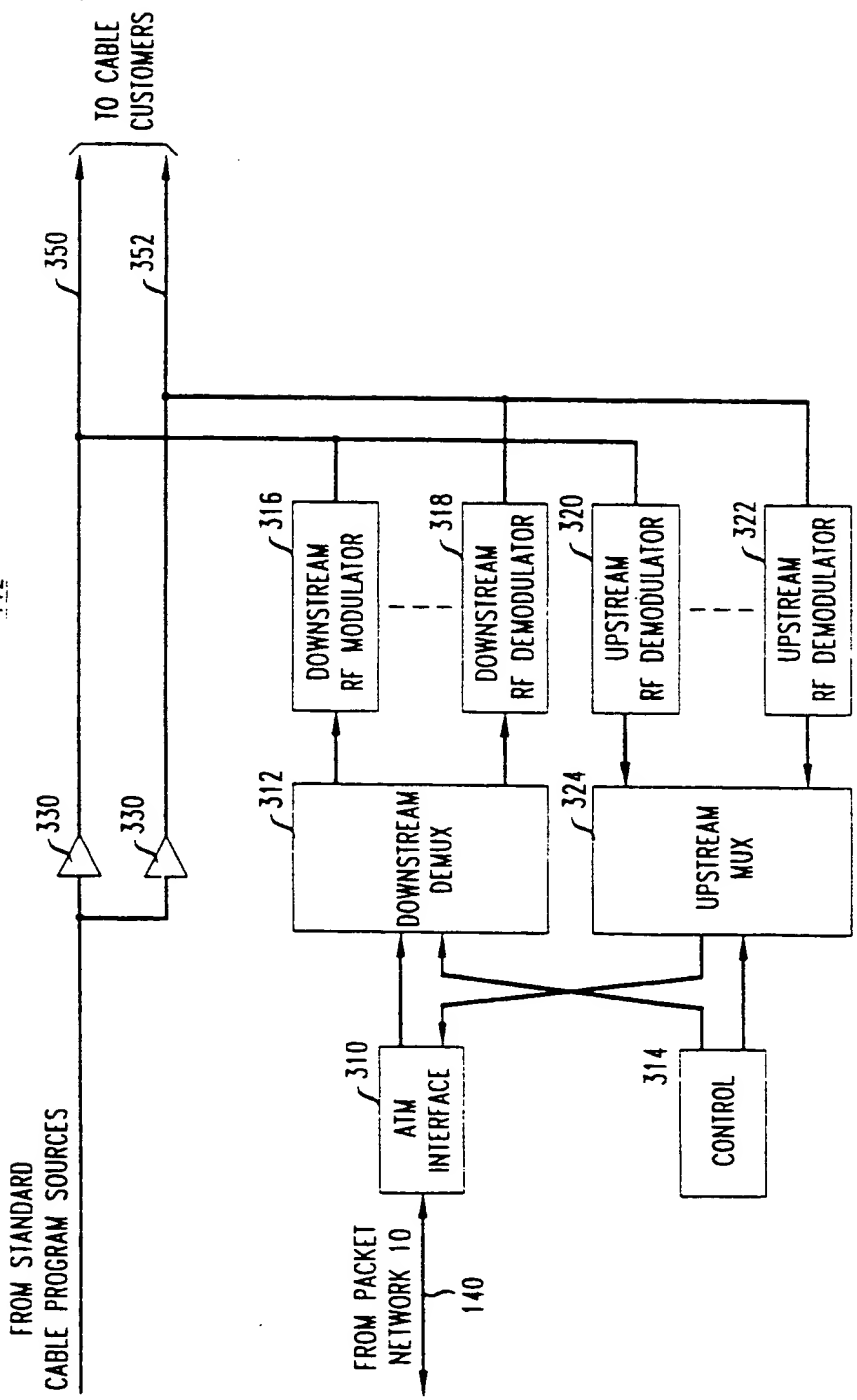

112
TO CABLE CUSTOMERS
350
352
330
330
FROM STANDARD CABLE PROGRAM SOURCES
316
DOWNSTREAM RF MODULATOR
318
DOWNSTREAM RF DEMODULATOR
320
UPSTREAM RF DEMODULATOR
322
UPSTREAM RF DEMODULATOR
312
DOWNSTREAM DEMUX
324
UPSTREAM MUX
310
ATM INTERFACE
314
CONTROL
FROM PACKET NETWORK 10
140

FIG. 4

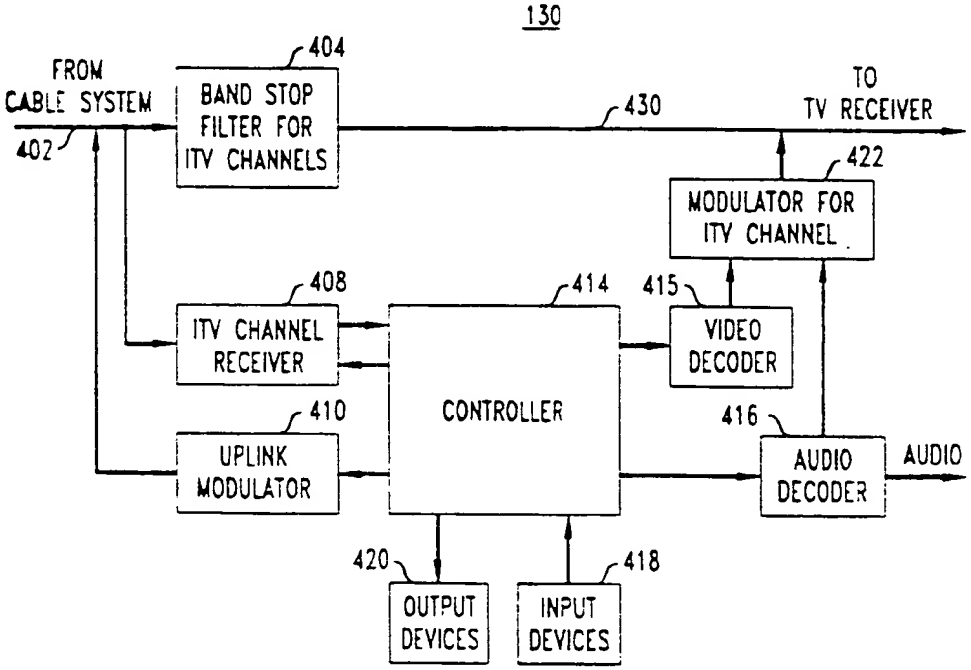

130
404
FROM CABLE SYSTEM
402
BAND STOP FILTER FOR ITV CHANNELS
430
TO TV RECEIVER
422
MODULATOR FOR ITV CHANNEL
408
ITV CHANNEL RECEIVER
414
CONTROLLER
415
VIDEO DECODER
410
UPLINK MODULATOR
416
AUDIO DECODER
AUDIO
420
OUTPUT DEVICES
418
INPUT DEVICES

FIG. 5

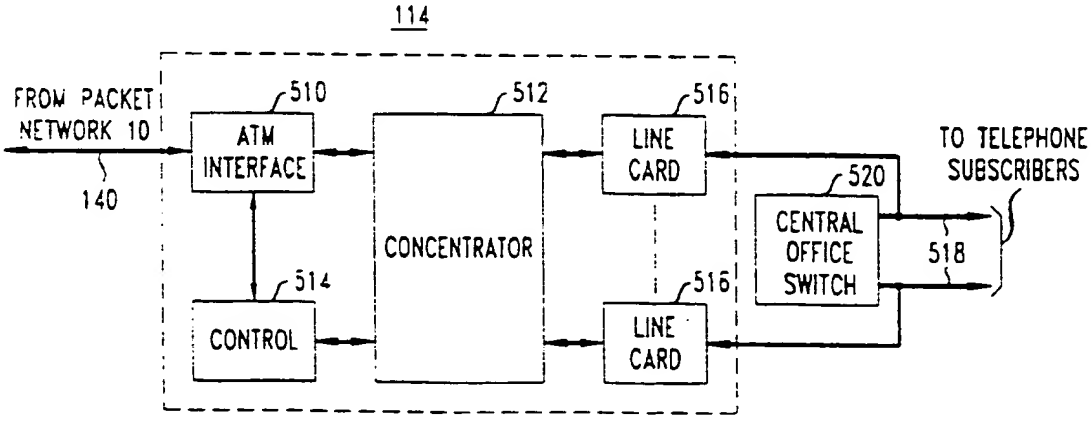

114
FROM PACKET NETWORK 10
140
510
ATM INTERFACE
512
CONCENTRATOR
516
LINE CARD
TO TELEPHONE SUBSCRIBERS
520
CENTRAL OFFICE SWITCH
518
514
CONTROL
516
LINE CARD

FIG. 6

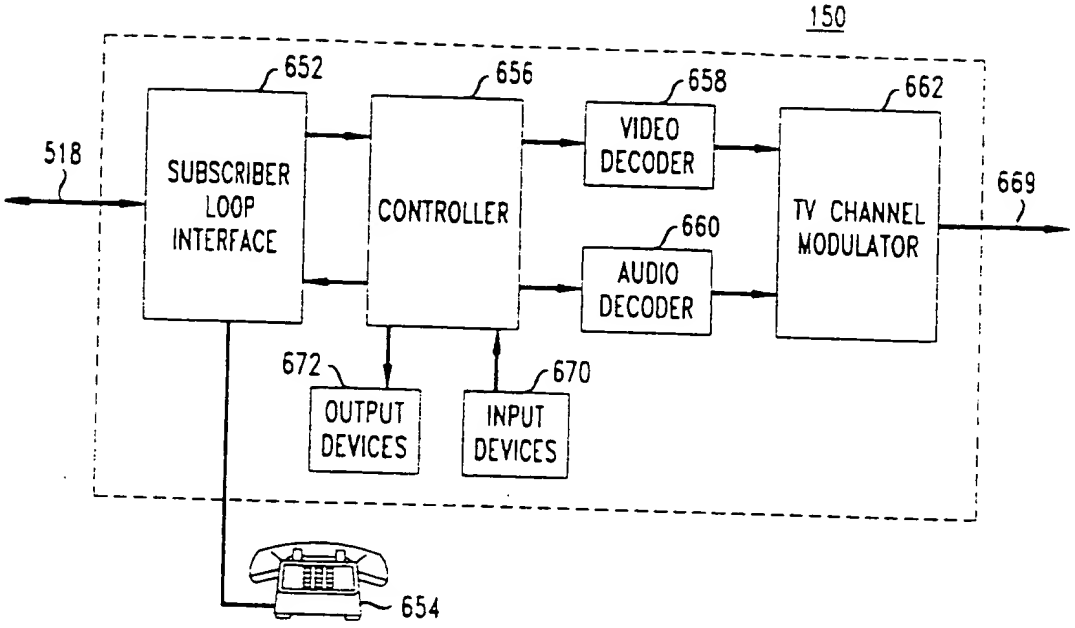

150
652
656
658
662
518
SUBSCRIBER LOOP INTERFACE
CONTROLLER
VIDEO DECODER
TV CHANNEL MODULATOR
669
660
AUDIO DECODER
672
670
OUTPUT DEVICES
INPUT DEVICES
654

FIG. 7

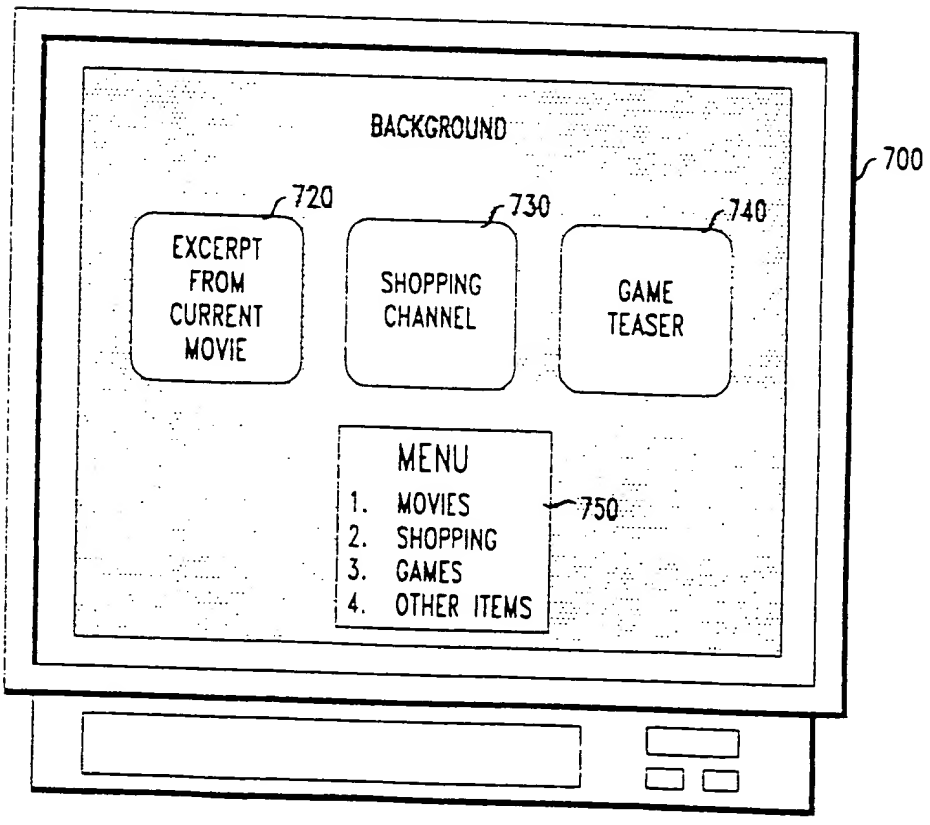
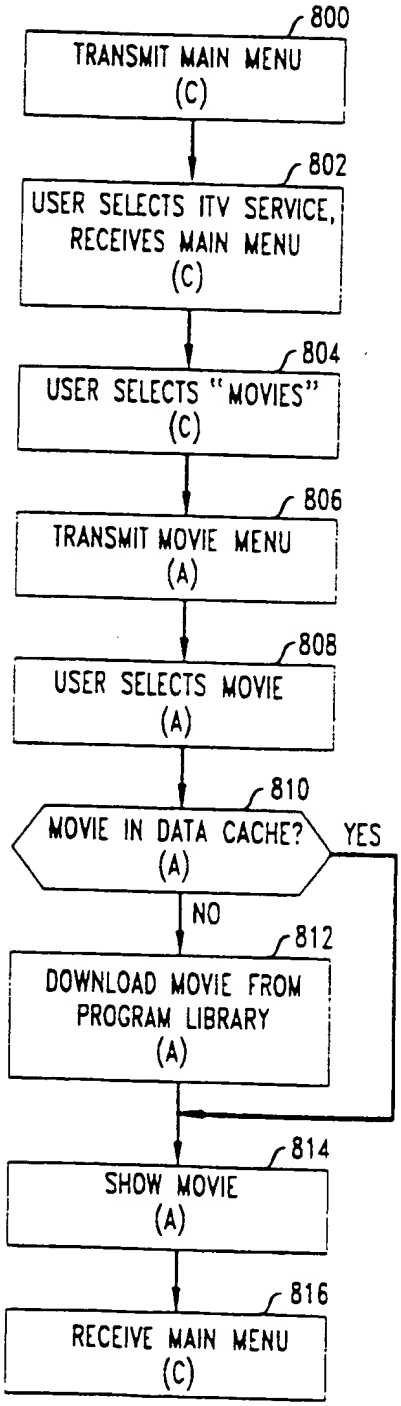

710
700
BACKGROUND
720
730
740
EXCERPT FROM CURRENT MOVIE
SHOPPING CHANNEL
GAME TEASER
MENU
1. MOVIES
2. SHOPPING
3. GAMES
4. OTHER ITEMS
750

FIG. 8


800
TRANSMIT MAIN MENU
(C)
802
USER SELECTS ITV SERVICE,
RECEIVES MAIN MENU
(C)
804
USER SELECTS "MOVIES"
(C)
806
TRANSMIT MOVIE MENU
(A)
808
USER SELECTS MOVIE
(A)
810
MOVIE IN DATA CACHE?
(A)
YES
NO
812
DOWNLOAD MOVIE FROM
PROGRAM LIBRARY
(A)
814
SHOW MOVIE
(A)
816
RECEIVE MAIN MENU
(C)